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NOTES ON THE DISSECTION AND BRAIN OF THE CHIMPANZEE "GUMBO."

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Notes on the Dissection and Brain of the Chimpanzee "Gumbo" (*Troglodytes niger*).

By Thomas Dwight.

Read May 15, 1895.

"Gumbo" was a very fine male chimpanzee who at one time was kept in the Royal zoological gardens at Lisbon. He was leased to a museum at Boston, where he died in the autumn of 1894 of general tuberculosis. He had probably reached very nearly his full size, though the last of his second teeth had not taken their permanent position, and some of the epiphyses were distinct. Before his sickness he was remarkably muscular. He is said to have been very intelligent, but was not trained to rival "Sally." His temper was violent. I regret that I never saw him alive. Even after death he did not come into my hands until after the autopsy. This was performed more than twenty-four hours after death. The progress of putrefaction combined with the effects of tuberculosis had made the condition of the thoracic and abdominal cavities truly frightful. The viscera and skin were practically worthless. The brain, happily, was perfectly healthy. The body was then sent to the Harvard medical school and dismembered as soon as possible. There was a great deal of very black hair about the face. Indeed, the hair was black, or nearly so, everywhere. There were bare spots, almost callosities, over the tuberosities of the ischia.

The height, measured after the removal of the brain, from vertex to heel, the leg being straightened as much as possible, was about 131 cm. This must be regarded as only approximate.

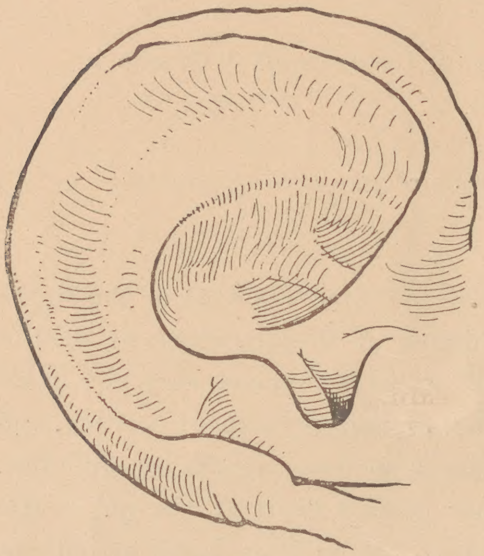
The length of the hand from the fold at the wrist to the end of the middle finger was 24.4 cm. on the right. The left was 1 mm. longer. The length of the foot to the end of the third toe was 24.7 cm. on the right, and 2 mm. less on the left. The great toe resembled strikingly a human thumb, and the lines on the sole of the foot were much more like those of the human hand than were those of "Sally" as shown in Mr. Beddard's[1] figures. The lines of the hands and feet are well shown in the reproductions of the photographs (pl. 7).

The ear is admittedly very variable in the chimpanzee. Those of "Gumbo," like those of the *T. aubryi*[2] and of "Mr. Crowley," the New York chimpanzee, are more

[1] Trans. zool. soc. London, vol. 13. 1893.

[2] Gratiolet and Alix, Nouv. arch. mus d'hist. nat. Paris, tome 2. 1866.

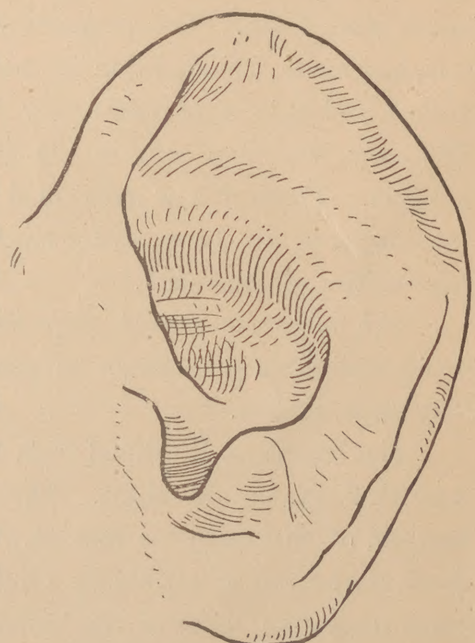
human than those of "Sally" which are prolonged further upwards away from the head. In "Gumbo" the two are very unlike. Their proportions differ considerably. The right one is 8 cm. long by 6 cm. broad, while the length of the left is 8.7 cm. and its breadth 5 cm. The length in the *T. aubryi* is 7 cm., that of "Mr. Crowley's," taken from a cast, is 9 cm. and the breadth 5.5 cm., that of "Sally," taken from the life-size illustration, is length, 7.6, breadth, 5.3 cm.



Right Ear.

In "Gumbo" the notch is well marked on both sides, but narrower in the narrow left ear. There is a very rudimentary lobule, stronger on the left. This is present in the *T. aubryi*, and quite wanting in "Sally." The ascending part of the helix of the left ear folds over much more strongly than on the right, but the fold is interrupted at the top on the left, while in the right it is continued into the posterior border. After this interruption, however, the fold of the helix along the back of the ear is stronger on the left than on the right.

It would be presumptuous to dispute with the distinguished authorities who declare that there is more than one species of chimpanzee. There can be no question, however, that the range of individual variation is very great in the details of the skeleton, of the muscles, and of the brain. It has not seemed advisable to publish a full description even of those parts of this animal which could be thoroughly studied. In this paper particular attention is given to the brain and to peculiarities in the muscular system of the extremities.



Left Ear.

The Age.

According to very vague information which I have received, this animal was ten or twelve years old. "Sally," who lived more than eight years at the zoological gardens in London, was thought to be about two years old when she came. The chief criterion of

age being the teeth and the progress of ossification, it may be well to describe the former at this point and to compare them with "Sally's."

Teeth.

The second dentition was complete, excepting that the right inferior canine had not very much more than cut the gum. The fangs of the third molars and superior canines had not yet reached their full development. The left inferior canine and the two left inferior incisors are wanting and no signs of their alveoli remain. There is reason to fear that they had been drawn in order to teach the animal to smoke. The teeth of the upper jaw in this neighborhood are much distorted, the canine projecting forward and outward, and the lateral incisor being bent strongly inward. The first premolar of that side has practically no roots. The bone is hypertrophied internal to the displaced socket of the canine. The crowns of the molars are little worn. In the upper jaw they are of very nearly the same size, but in the lower jaw the crown of the second is the largest and that of the first rather the smallest. In the upper jaw the first and second molars have two external and two internal cusps, the third differing in having only one internal one. In all of them the internal cusps are not at the edge of the crown, but separated from it by a considerable oblique surface. I fail to recognize any distinct oblique ridges between the cusps. Each of the inferior molars has three distinct external cusps. The first and second have two internal ones. The posterior of these latter is indistinct on the right third molar and wanting on the left one. Barring this, the inferior molars resemble those of the *T. aubryi.*

Mr. Beddard gives the following account of "Sally's" dentition: "In the upper jaw the permanent incisors and bicuspids are present; the first molar is the only one of the molar series which is in place. The canines are a long way from their definitive position; the point of the tooth is fully half an inch from the rim of the socket; the extremity of the root of the tooth is barely half an inch from the rim of the orbit. . . . . The milk canines are the only representatives of the milk teeth which have not been replaced." It is clear that "Gumbo" is further advanced. I do not presume to say what period of time this difference represents. It goes to show, however, that he can hardly have been younger than ten and may well have been a year or two older. This is important as showing the progress of ossification at that age.

Ossification.

The cranial sutures are distinct, but none of the bones show any disposition to fall apart after maceration; indeed, they could not be separated without injury. The suture

between the basi-occipital and the basi-sphenoid is quite open on the outside of the base, and closing within. (I have observed that these surfaces in the human skull join in the same order.) All traces of sutures between the maxillae and premaxillae are lost.

The upper epiphysis of the humerus and the lower one of the femur are still separate; those at the other end of these bones have joined. The radius and ulna have the lower epiphyses free and the upper ones fused. In the tibia the lower end is still free and the upper has but very recently united by bone. In the fibula both ends are still free. The scapula has the end of the acromion and the inferior angle free; the posterior border is still rough, but if any distinct epiphysis existed it has been lost. In the innominate bone there is a very faint trace of suture remaining opposite the acetabulum. The epiphysis over the tuberosity is joined, but its continuation on to the ramus is presumably lost. The crest is unfinished. The plates on the bodies of the vertebrae are in many instances (probably in most) still separable. In the sternum the manubrium is, of course, distinct. Cartilage still separates the first piece of the mesosternum from the others which form one bone. The ensiform is wholly cartilaginous.

The Skeleton.

The skull. This, like the rest of the bones, is large and strongly marked. Greatest length from posterior occipital protuberance to the front of the premaxillae, 19.5 cm. Greatest breadth a little back of ear in the continuation of the occipital curved line, 13.1 cm. Cranial capacity 430 cc. The temporal ridges are strong. Their nearest approach to each other is 5 cm. in the frontal region; their greatest separation is 9.5 cm. at their termination. The orbital borders are rather more strongly raised than in most skulls. The interorbital region is concave vertically. The orbital index of the right orbit is 100; that of the left, 88. (The transverse diameter is taken to the posterior border of the lachrymal groove.) Observations on several chimpanzee skulls impugn the statement that the transverse diameter of the orbit always considerably exceeds the height. The sphenoidal fissure is small; seen from the inside it does not appear much larger than the optic foramen. Beddard mentions its large size in *T. calvus*. Sutton[1] states it is large in *T. niger*. The extremity of the petrous is nearly 1 cm. in advance of the suture between the basi-occipital and sphenoid on the outside of the skull; on the inside the distance between them is more than half as great. The crista galli is rudimentary. The fossa above the cribriform plate is very deep; much deeper than in "Sally," as is shown by the brain.

[1] Journ. anat. physiol., vol. 18.

The spine. The vertebral formula is C. 7 T. 14 L. 3 S. 6 C. 3. The last piece of the coccyx is narrow and elongated. It may represent more than one element. The head of the first rib encroaches on the seventh cervical vertebra. The head of the fourteenth, about 10 cm. long, rests on a little elevation on the vertebra. Almost touching the head is a rudimentary tubercle. The cartilages of seven ribs reach the sternum.

The greatest length of the humerus is 31.7 cm., and that of the femur, 32.3 cm. This is stated by way of giving an idea of the size of the bones, which is important in connection with the process of ossification.

There are few points in the bones of particular interest. As usual, there is no supra-trochlear perforation of the humerus. Each femur has a small, but well-marked, third trochanter, and below it a shallow, roughened groove, the fossa hypo-trochanterica (pl. 8).

Muscular System.

The muscular dissection was limited to the extremities. The plan which I pursued (with some few lapses) was to describe what I found without refreshing my memory as to chimpanzee anatomy. When this was done, I consulted the authorities. I have made especial use of Mr. Hepburn's[1] account of the limb-muscles of the four anthropoids. I give only what seems to me interesting or peculiar. The most important points are probably the arrangement of the flexors of the fingers, the anomaly of the pronator quadratus, the redundance of interossei in both hand and foot, and perhaps the peculiarity of the femoral adductors.

Upper Extremity.

Latissimus-dorsi and *dorso-epitrochlearis.* The latissimus joins the edge of the teres major and receives fibers from it, which might be said to represent a scapular head. The epitrochlear muscle springs from the anterior aspect of the tendon of the latissimus; is perhaps 1 inch broad at origin, runs to tip of the internal condyle, the last 2 1-2 inches being tendinous. This resembles strikingly Beddard's account of "Sally" and differs from all Hepburn's anthropoids.

Deltoid. Strong. The clavicular part closely connected with the greater pectoral which would appear to be the rule. Some of its fibers seem to join the brachialis anticus.

[1] Journ. anat. physiol., vol. 26.

Coraco-brachialis arises from the coracoid and from the internal border of the short head of the biceps for some 4 inches. It is pierced by the musculo-cutaneous nerve. It divides into two parts. One, tendinous, is inserted into the inner part of the front of the humerus from a little above the middle to the junction of the second and lower thirds or even further. The other part, chiefly muscular, is inserted into the internal muscular septum in the lower third of the arm and by an expansion into the fascia of the arm, being fused with the termination of the dorso-epitrochlearis.

Triceps. The only point to be noted is that, besides its usual insertion, it expands into the fascia of the back of the fore-arm.

Pronator radii teres has two heads with the human relations to nerve and artery (*vide flexor carpi radialis*).

Palmaris longus is inserted more to the radial side than in man.

Flexor carpi radialis. Besides the usual origin it arises from the oblique line of the radius by a fibrous layer which gives origin to the fibers of the pronator teres ; below the oblique line it arises from the anterior border of the radius to within two inches of the lower end. It is inserted into the base of the second metacarpal. This origin resembles that seen in the gorilla but not in "Sally" nor in Hepburn's chimpanzee. The insertion is the same as that seen in "Sally." In both respects it agrees with Gratiolet and Alix's *Troglodytes aubryi.*

Flexor carpi ulnaris. A tendinous slip arises high up from the deep aspect of its ulnar aponeurosis of origin. From this a series of short muscular fibers run obliquely downward and outward to another parallel tendon which, lying superficial to the flexor tendons of the fingers, is inserted into the annular ligament to the radial side of the pisiform, which bone receives the main tendon. The ulnar nerve comes to the surface between the two tendons. (The deep tendon gives origin to some fibers of the flexor sublimis digitorum.)

This may be called either a double insertion of this muscle, or we may say that there is an extra palmaris longus. Something resembling this seems to have been seen in gorilla by Duvernoy.

Flexor sublimis digitorum arises (1) from the common condyloid muscular mass and septa within it, (2) from the coronoid, and (3) from the oblique line of the radius. This head is attached also along the anterior border to within about 2 1-2 inches of the lower end. The tendon of the little finger arises from the superficial mass on the ulnar side. The tendon of the annularis arises from the superficial mass more anteriorly. It receives an insignificant reinforcement from the top of the oblique line of the radius. The tendon of the middle finger receives its fibers from the coronoid head and from practically the whole radial origin, whence the fibers run into the edge and

anterior surface of the tendon. This is much the largest tendon. That of the index arises as a small muscular belly from the coronoid, soon becomes tendinous, and sends a small muscular bundle to the division for the third finger. It then gives off a series of short oblique fibers, which run to another parallel tendon which is the terminal one. It passes obliquely under the others just above the wrist. The three inner tendons pass under the annular ligament in the same plane, that for the little finger being a shade behind.

Expressed differently, the condyloid head supplies the fourth and fifth fingers (the latter receiving a trifling bundle from the radius). The coronoid head goes to the middle finger and index. The radial head goes to the middle finger.

N. B. A connecting link with the flexor profundus arises as a muscle, perhaps 1-2 inch broad and from 5 to 6 inches long, from the coronoid portion. Its tendon becomes the deep tendon of the index and receives on its radial side the fibers of the radial portion of the muscle next described.

Flexor profundus digitorum is very clearly divided into a smaller radial and a larger ulnar part. The former arises from the front of the radius and a little of the interosseous membrane; all its fibers go into the connecting link just described, which is the tendon of the index. The ulnar portion (separated from the radial by the anterior interosseous vessels and nerves) divides into three tendons. That for the minimus comes from a muscular belly that is distinct nearly half way up the fore-arm. The other two are much more closely connected. The ulnar portion also gives some muscular fibers to the index tendon.

Flexor longus pollicis has *no* existence whatever as a muscle. A minute tendon first appears a little above the annular ligament as a thickening of the delicate sheath of the radial part of the *flexor profundus*. As it descends it grows stronger, becoming a well-defined little tendon, perhaps 1.5 mm. broad, going to the second phalanx of the thumb. This has been repeatedly seen in the chimpanzee, but usually the tendon comes directly from the muscle.

There can be, I think, no question that in this flexor group the anthropoids exhibit much individual variation. The accurate comparison of the different descriptions is more wearisome than profitable, owing to the complication of the structure. The accounts all differ more or less. The connecting slip from the superficial flexor to the deep one is not normal in the chimpanzee, but occurs as an anomaly as it does in man. In " Sally " such a slip was found going to the deep tendon of the ring finger.

Lumbricales are four in number. The first arises from the radial side of the tendon of the index; the second from the other side of this tendon and the radial side of the tendon of the medius. The third springs from the neighboring sides of the tendons

of the medius and annularis; the fourth from the ulnar side of the latter. The accounts of these muscles in various chimpanzees show trifling differences in most cases.

Pronator quadratus. Similar on both sides. It is in two layers which are only partly separable. The more superficial begins as a tendon at the top of the ulnar origin and expands as it passes downward and outward across the muscle. It gradually becomes muscular, and having reached the outside of the radius, runs downward (hidden by the flexor carpi radialis) to the ridge of the trapezium. It is about 7 mm. broad at the end. The deeper, more transverse part of the muscle runs somewhat slanting downward to the radius. A few fibers near the radial side go to the front of the capsule of the wrist.

This is an anomaly very rarely observed in man. I cannot find any record of it in the chimpanzee. Macalister observed it in a Bengal tiger, though it is not normal in the Felidae. It seems to show that animals of diverse groups have a tendency to similar variations which are not determined by heredity.[1] I am not aware that the pronator quadratus as above described is normal in any mammal.

Palmar muscles of the thumb. Abductor brevis runs from the annular ligament and sesamoid bone to the base of the first phalanx. Its tendon, reinforced by the flexor brevis, passes into an expansion with a tendinous insertion into the second phalanx.

Opponens pollicis from the annular ligament more or less fused with the flexor brevis.

Adductor pollicis transversus from the fibrous aponeurosis which is stretched over the fourth metacarpal. It arises directly from the distal part of the third metacarpal. There is a slight interspace allowing it to be divided into a proximal and a distal part; both in the same plane.

Adductor obliquus from the base of the third metacarpal to the usual insertion and by a very small tendon to the second phalanx.

Flexor brevis has no inner head. Hepburn found a rudimentary one.

Palmar muscles of the little finger. Practically as in man.

The *interossei* are discussed after the other muscles of the fore-arm.

Extensor communis. Not remarkable. Portion for index easily separable in the lower third of the arm. The tendon for the little finger sends fibers to the fourth. Wilder[2] found no tendon to the little finger.

Extensor minimi digiti. This supplies both the fourth and fifth fingers (as Hepburn describes for the orang-outang and Beddard for "Sally").

The action of the extensor tendons seems to be nearly limited to the first phalanges.

[1] The significance of anomalies. Amer. nat., Feb., 1895.

[2] Proc. Bost. soc. nat. hist., 1861.

Abductor pollicis longus to trapezium and sesamoid bone.

Extensor primi internodii pollicis is so fused with the preceding as to suggest one muscle with two tendons; it is inserted into the base of the first metacarpal on the radial side (better called extensor pollicis brevis).

Extensor secundi internodii pollicis, vel extensor pollicis longus, runs from the lower part of the ulna and interosseous membrane into a fibrous expansion over the back of the thumb, and is inserted into the second phalanx.

Extensor proprius indicis is a small muscle going to the index only; in Hepburn's chimpanzee it sent a slip to the ring finger.

Interossei manus. There are four dorsal, practically the same as in man. There are seven palmar; namely, two for the index, the middle and ring fingers, respectively, and one for the little finger. The smallest of these is the first. It arises from the radial side of the metacarpal bone of the index internal to the belly of the dorsal. The second is a large one on the ulnar side of the index. The third and fourth lie on the metacarpal of the middle finger, touching each other and arising in part from a fibrous septum between them. The third receives also a few fibers from the base of the second metacarpal. The fifth and sixth arise (excepting for the last detail) in a similar manner from the fourth metacarpal. The seventh arises from the radial side of the fifth metacarpal and from the hook of the unciform.

There is (with one exception) an important difference between the insertion of the dorsal and palmar interossei. The dorsal are attached to the sides of the bases of the first phalanges, still the chief action is to flex them; lateral movement is not great. The palmar ones end in well-defined tendons which run along the sides of the first phalanges and end in the fibrous expansion over their dorsal aspects. Their chief action is to flex the first phalanges and extend the second and third. The exception alluded to is the first palmar which has a very small tendon more or less fused with that of the first dorsal.

The chimpanzee has been described as having six palmar interossei, my little first one not having, I believe, been hitherto observed. I have called it a palmar interosseous because it seems to me a distinct muscle; still its mode of termination gives support to those who would call it a part of the first dorsal. For the others not found in man I cannot admit this interpretation. They are all in the same plane and have a similar insertion. Compare Hepburn on anthropoids, Cunningham on Thylacine (Journ. anat. physiol., vol. 12), and Champneys on chimpanzee (ibid., vol. 6).

Lower Extremity.

Gluteus maximus. Origin as usually described, including a thick portion from the tuberosity of the ischium. It is inserted into the fascia lata, into the gluteal ridge and back of the femur quite down to the external condyle and joining the tendon of the biceps at the knee. This is a somewhat lower insertion than is usually described.

No separate *tensor vaginae femoris.* A small one is usually found.

Scansorius arises from the anterior border of the ilium and is inserted in common with the gluteus minimus.

Pyriformis inseparably connected with gluteus medius.

Gemellus superior, broad; *gemellus inferior*, small.

Quadratus femoris. A small muscle, arising from the front of the tuberosity of the ischium, runs to the posterior intertrochanteric line, reaching lesser trochanter. (I do not find Hepburn's vertical part.)

Biceps femoris. Has the two parts distinct. The ischial portion goes to the head of the fibula, sends an expansion to the front of the external tuberosity of the tibia, and is connected with the sural fascia. The femoral portion runs to the head of the fibula and to the fascia of the calf.

Quadriceps extensor, differing from that of "Sally," is easily separable into four parts. The *vastus internus* overlaps the cruraeus from which it is much more distinct than is the vastus externus. *Rectus* has both heads.

Gracilis seems three or four times as strong as *sartorius;* they both end in broad expansions which are inserted more than one third and one half way down the leg, respectively.

Adductor group is very puzzling.

Pectineus is small, but distinct.

Adductor magnus arises from the tuberosity of the ischium and runs down as a thick round belly to the adductor tubercle. This seems to be the whole muscle, being perfectly distinct. The femoral artery passes back between it and the muscle now to be mentioned, to become the popliteal. This is an extremely thick and strong muscular mass arising from the front of the pubes and from the pubic arch and running to the linea aspera. Separate muscles are not to be made out. I recognized no *adductor longus* nor *brevis.* It represents all the adductors of human anatomy except the vertical portion of the adductor magnus. This division of the adductor magnus into two parts is normal in the chimpanzee, but the fusion of one

part with the other adductors is peculiar. Wilder found the *pectineus* and three adductors present but more intimately connected than in man.

The anterior muscles of the leg, the *peronei*, those of the calf, present nothing noteworthy. The *plantaris* is present and distinct, going partly to the *tendo Achillis* and partly to the fascia at the inner side of the ankle. This muscle seems to be at least as often wanting as present. An insertion much like the present one is described by Humphry.

Peroneus longus and *brevis* are inserted respectively to the base of the first and of the fifth metatarsals. Neither has any further insertion.

Extensor brevis is remarkable only for the fact that the first division sends an additional insertion to the second phalanx of the great toe.

The tibial and fibular flexors (*flexor longus* and *flexor hallucis*) are inserted as follows: the former goes to the second, fourth, and fifth toes, the latter to the first, third, and fourth.

Flexor brevis is very small, arising in part from the os calcis. It divides into three little tendons for the second, third, and fourth toes. It receives muscular fibers in common with the lumbricales from the tendons of the long flexors which go to the third and fourth toes. This muscular slip represents the *flexor accessorius.*

Lumbricales are four in number. The first arises from the tendon of the tibial flexor, the others from the tendons of the fibular flexor.

The head of *flexor brevis* from the tendons is very confusingly mingled with the *lumbricales.*

Adductor hallucis transversus arises from nearly the whole length of the fourth metatarsal and from the distal ends of the shafts of the second and third.

Adductor obliquus is hardly separable from the preceding. It arises from the sheath of the *peroneus longus* at the basis of the second and third metatarsals.

Interossei pedis. There is a great complication of these muscles, there being five or six both dorsal and plantar. The reason for this vague enumeration appears in the description.

Dorsals. First muscle from the first and second metatarsal bones to the tibial side of the second toe. The second and third muscles arise each from two bones, and are inserted into the two sides of the medius, thus placing the base line in this toe. The fourth muscle is a very small one, placed on the dorsal aspect of the fourth metatarsal and inserted on the tibial side of the phalanx. The fifth and sixth muscles arise together from the last two metatarsals and are inserted into the adjacent sides of the last two toes. This might be called a single muscle with two insertions.

Plantar interossei. The first is where it should be, on the fibular side of the second

nerve. The two presumably represent the superior profunda. Later a small branch runs to the under side of the biceps, and a few supply the elbow joint. The division into radial and ulnar occurs about one inch below the elbow joint. The whole arrangement is as in man (very different from *T. aubryi*); the radial descends in the usual way to the *tabatière*, and then passes into the depth of the palm. The ulnar, which is the larger branch, passes under the pronator teres, the deep head of which separates it from the median nerve. Its distribution in the hand is essentially human. An interosseous artery was given off which was subsequently lost.

With the exception above mentioned this in essentials corresponds to other chimpanzees.

The femoral artery about one inch below Poupart's ligament gives off a small external branch, probably the external circumflexa ilii, and, a little lower, a small one running internally. At about the same level the profunda arises from its deep aspect. From this springs an external circumflex which divides into ascending and descending branches and a small lateral one. The descending runs on the vastus externus to the outside of the knee. The profunda runs probably[1] through the thick mass of adductor muscles, sending back perforating branches.

The femoral runs anteriorly to the adductor mass to the inside of the lower third of the thigh, where beneath the sartorius and the anterior border of the gracilis it divides into the popliteal and the saphenous. The popliteal, which is rather the larger of the two, passes back external to the muscle representing the vertical part of the adductor magnus. Besides articular branches it gives one long sural branch and divides into the anterior and posterior tibials. The former passes forward at once as in man and descending to the ankle ends in a network over the metatarsal bones. The posterior tibial gives off a peroneal branch, neither of which was fully traced.

The saphenous artery gives a considerable branch to the inner side of the knee joint and passing between the *sartorius* and *gracilis* comes to the surface opposite the inner tuberosity of the tibia. It then runs down along the inner side of the leg in company with a vein *beneath* the fascia. It crosses above the internal malleolus to the front of the foot and plunges into the sole between the bases of the first and second metatarsal bones.

Gratiolet and Alix describe the arteries of the lower leg practically as here. They say, however, of the saphenous artery that "Elle se place superficiellement sous la peau, le long de la face interne du tibia, etc.," while I find it beneath the fascia. Zuckerkandl[2] does not touch on this point. My observations, though less minute, agree with his, only that he finds the peroneal springing from the anterior *tibial*.

[1] I regret that my notes on this point are not perfectly clear. [2] Anat. hefte, 15, 1895.

The Larynx.

The general shape and structure are well known. Seen from above and behind (the posterior wall of the cricoid having been divided in the median line), the larynx is proportionately narrower than in man. The epiglottis is smaller and far less prominent. The fossae at the back of the tongue and the glosso-epiglottidean folds are much less marked. Another and more important consequence is, that the aryteno-epiglottidean folds bounding the entrance to the larynx proper do not project nearly so freely as in man. The notch behind is narrower and deeper. The prominence on either side formed by the cartilage of Santorini is further forward, taking the place occupied by the cartilage of Wrisberg, which in this animal is wanting.

The hyoid apparatus consists, as usual in apes, only of the basi-hyal and of two thyro-hyals. The body of the bone is short and strongly curved upward as well as forward. Its breadth measured in a straight line from side to side is 2.4 cm. The thyro-hyals, which are connected by joints, measure, the right 4.2 cm., and the left 3.8 cm.

The two halves of the thyroid can be separated or approximated with such ease that a want of union was suspected, but a cross-cut at the angle showed that the cartilage is continuous. There is but a slight forward projection of the angle. The vertical length of this between the two notches is 2.2 cm. Both cornua bend strongly inward, especially the upper. The oblique line ends below in a very prominent tubercle which overhangs a deep fossa. The fibers of the crico-thyroid muscle are inserted into the lower border of the cartilage, the tubercle, the fossa behind it, and the inferior cornu. There is a suggestion of a separation into two layers described by Gratiolet and Alix The superior cornu is separated from the extremity of the great horn of the hyoid by a nodule (*cartilago triticea*) which touches both. The flexibility of the superior cornu is very striking.

The cricoid cartilage has not been uncovered, for it was thought best not to dissect the larynx. Its height in front is 7 mm. and behind 2.1 cm.

The arytenoids, for the same reason, are not accessible.

The true vocal cord is 2.3 cm. in length. Its delicacy has been described by others. It seems nothing more than a very thin fold of mucous membrane. The greatest distance between the true and false cords across the middle of the entrance of the ventricle is 5 mm.

The *ventricles and the roaring sac.* Each ventricle is prolonged upward behind the hyoid to the side of the epiglottis for more than 1 cm. from the superior cord. The

left ventricle ends blindly. The right ventricle opens at its anterior part by an opening, which it is hard to see from the inside, into an anterior expansion. A rod 6 mm. in diameter, introduced from in front, fully distends the passage. I regret that I was not present when the roaring sac was opened by the primary incision at the autopsy. It was described as immense, extending over the front of the neck and the top of the chest outward as far as the coracoids. The portion still connected with the specimen passes up under the hyoid where it is sacculated. The communication with the larynx is just to the right of the median line.

The Tongue.

This organ seems hardly to have received the attention it deserves. It is longer and broader than in man. While strikingly similar, it presents some noteworthy differences. As in the human tongue the anterior two thirds of the dorsum are to be sharply distinguished from the posterior one, which has the *papillae circumvallatae* near its front and is occupied by adenoid tissue and mucous glands. In "Gumbo" the anterior two thirds besides the filiform papillae have very many fungiform ones, especially near the tip. What is remarkable is, that the characteristics of the dorsal mucous membrane are prolonged at the tip onto the inferior surface for 5 mm. or more. In the posterior third there is an oval swelling of the whole tongue in the middle, while in man there is a median furrow. The circumvallate papillae, some seven in number, are arranged rather like a T than a V. In some cases two papillae are surrounded by the same mote. The surface of the very posterior part is very irregular, owing to accumulations of adenoid tissue. Very striking is the large number of orifices looking like small pin-holes to the naked eye. Whether these are really the openings of large ducts or simply little cavities between adenoid collections can be determined only by the microscope. The papillae foliatae are more strongly developed than in man. These constitute a system of transversely placed ridges and furrows extending along either side of the tongue just in front of the end of the anterior pillar of the fauces. This system describes a marked curve with an inward convexity. From this in the anterior part of the posterior third of the tongue among the large papillae and somewhat in front of them is a curious system of curved raised lines suggesting that of the tips of the fingers.

The Caecum.

The caecum (pl. 8.) was the only part of the intestines saved. The vermiform process was divided some six inches from its origin, so that its length is not known. The

caecum is not unlike a human one, being broader than long. It is a good example of Treve's third class, namely, that commonly found in man. It is very different from that figured by Gratiolet and Alix, which is long and tapering. A window cut in the dried and inflated specimen shows an ileo-caecal valve extending obliquely upward and outward from the inner side of the gut so as greatly to increase the size of that part of the intestine which must be called the caecum. The slit is 2.4 cm. long. The valve is continued about two thirds of the distance round the gut. Its greatest breadth is about 3 cm. Beneath it in the caecum, starting at the inner side from its under surface, is another smaller fold which diverges from it. This is best marked toward the posterior surface of the caecum. There is a small valve guarding the upper part of the entrance of the appendix.

The ascending colon is very large and strongly sacculated.

The Brain.

According to agreement the brain was so hardened as to make it fit for microscopic sections. The hemispheres were put at my disposal for the study of the convolutions. The length, after hardening, is 11.2 cm., the breadth, 9.4 cm., the height, 6.7 cm. Seen from the front there is a strong median downward projection of the frontal lobes where they rest on the cribriform plates. This keel is much greater than in "Sally," but perhaps a little less than in Benham's[1] figure of a common chimpanzee. The points which at first sight are most noteworthy and characteristic of this particular brain are the large size and diagrammatic appearance of the frontal and occipital convolutions in contrast to the small size and complication through small fissures of the parietal and temporal ones. There is a decided want of symmetry between the two halves.

Fissure of Sylvius. The main limb ends with a bifurcation on both sides of the brain. On the *left* side the anterior limb is easily recognized. It runs forward and ends in a bifurcation, the two parts of which make a slight concavity around a part of the third frontal, representing clearly enough the *pars triangularis*, Broca's promontory (pl. 9, fig. 1). In short, this is the Y plan often seen in the human brain, only the arms of the Y are short and widely opened. On the right there is no anterior limb at all, unless a depression on the third frontal in front of the praecentral fissure can count as a rudiment. This is precisely where the fissure should be. The little *subcentralis anterior* and the *praecentralis* are behind it and the *orbito-frontalis* in front of it. If the identification on the left side be correct, it will be observed

[1] A description of the cerebral convolutions of the chimpanzee known as "Sally," etc. Quart. journ. micr. sc., Nov., 1894, pl. 7.

that in front of the fissure of Rolando we find in order, first, the *anterior subcentralis*, then the *praecentralis*, then the anterior limb of the Sylvian, and finally the *fronto-orbitalis* (of Kükenthal and Ziehen[1]). The same series on the right is found by the interpretation offered above.

Fissure of Rolando. Exceedingly plain and diagrammatic on the left, showing very clearly the two knees. The upper end opens on the mesial surface. The lower does not reach the Sylvian fissure. The same is essentially true of the *right* fissure, but the knees are less well marked. The fissure cuts the median line at a distance of about 6.5 cm. measured directly backward from a straight line at the front of the brain. The frontal lobe must be described separately on the two sides. The left is taken first, as more resembling the human brain. The anterior central convolution is much larger than the posterior. It is directly continuous with the three frontal convolutions, the first at the side of the median fissure, the second a little above the middle, and the third at the lower end. The middle convolution divides the praecentral fissure into a larger inferior and a smaller superior part. Each of these receives a *sulcus frontalis;* the superior is short, ending in a bifurcation; the inferior is long and complicated, running to the very front of the brain where it ends with a sweep inward. There is another fissure (? pl. 10, fig. 1) very like one described by Benham in "Sally" which also has its upper end internal to the *frontalis superior*. It is well marked and deep, with an external branch. It is not clear whether it is to be called a continuation of the *sulcus frontalis primus* or a *frontalis mesialis*. The second frontal convolution fuses with the first at the front of the brain. The third frontal convolution arises from the very lower end of the anterior central, runs at first upward, then, turning forward, it surrounds the bifurcated anterior limb of the Sylvian fissure, forming a rudimentary but distinct *pars triangularis*. In front of this, it rises again to loop round the *sulcus orbito-frontalis*, which is a striking fissure. The inferior or orbital surface of the frontal lobe is not easily understood. A small fissure running to the mesial surface must represent the olfactory fissure. The general direction of the other fissures is forward and inward. The *sulcus orbito-frontalis* bounds it externally but behind runs into its inferior surface.

The right frontal region is very different in some important respects. The anterior central convolution is larger than the left one, consequently its predominance over the posterior is more marked. The second frontal convolution is very large in its first part. The superior praecentral sulcus is longer than on the left. The superior frontal sulcus runs forward almost to the orbital border of the brain. This is a very uncommon development of this furrow which I do not remember to

[1] Untersuchungen über die grosshirnfurchen der primaten. Jena. zeitschr., vol. 29, 1894.

have seen equalled in any figure of a chimpanzee brain. The *sulcus praecentralis inferior* almost reaches the fissure of Sylvius. Owing to the absence of the anterior limb of the fissure of Sylvius, the third frontal convolution at this region has the shape of a solid wedge placed base downward with an indentation on its surface which represents the anterior limb. It then winds over the *sulcus orbito-frontalis*. The second frontal fissure is interrupted by an annectant gyrus between the second and third convolutions. On the inferior surface, the olfactory fissure does not run to the median line. There is a deep fissure in the posterior part of the orbital surface curving forward and outward, which has no representation on the left. The median surface of the frontal lobe is left to be taken later.

The parietal lobe. The external parieto-occipital fissure, by which is meant that part of the internal one of the same name which extends into the convexity of the brain, is about 2 cm. long and similarly disposed in each hemisphere. It is surrounded by the *arcus parieto-occipitalis*, the classical *pli de passage*, which is quite uncovered by the *operculum*, but a little shut in anteriorly by the parietal lobe. The *sulcus occipitalis transversus* (Affenspalte), also symmetrical in the two halves, runs from the median line, just behind the *arcus* to the outer, lower, border of the hemisphere. In the first three quarters of its course it runs outward and slightly forward, then it bends strongly downward. The intra-parietal fissure is simple and nearly symmetrical. It consists of an inferior vertical part which is continuous with the main (horizontal) portion which runs into the Affenspalte just below the *arcus*. The superior vertical part is distinct. It can be called "vertical" only by homology, for it is decidedly more horizontal. The main limb just before entering the Affenspalte sends off a small branch which runs just in front of the arcus toward the median line.

The posterior central convolution is small. On the right it is evidently continuous along the whole length of the fissure of Rolando. It is continuous also on the left, though less evidently, for it is nearly cut through at the two knees of the fissure of Rolando above by the upper detached portion of the intra-parietal fissure, and below by a sulcus from the main stem. At the lower end this convolution expands on the left side into a triangular mass with a central imprint, probably representing the *sulcus subcentralis posterior*. The superior parietal convolution consists of two gyri separated in front by the upper part of the intra-parietal fissure which is here essentially horizontal. They unite behind it and are continued into the parieto-occipital arcus, bounding the fissure of that name, which is quite uncovered by the operculum.

The inferior parietal convolution divides into the supra-marginal gyrus surrounding the fissure of Sylvius and the angular gyrus which descends to the edge of the hemisphere

and then, rising sharply, is continued as the second temporal convolution. This applies to both sides.

The temporal lobe, so far as seen on the outside, requires little description. The parallel fissure below the first temporal convolution is, as seems always to be the case in the chimpanzee and in all the higher primates, remarkably clear and simple. It ends above with a bifurcation, around the lower branch of which the angular gyrus has to turn to reach the second temporal convolution as just described. The first temporal convolution is self evident. The second and third seem to be somewhat fused on both sides. Those on the under surface of the lobe will be considered later.

The occipital lobe, as seen externally, is marked by the large size and extreme simplicity of its convolutions. It looks like an undifferentiated mass on which a capital ⋈ has been imprinted, lying on its side with the stem forward. This is the *s. occipitalis obliquus*.

The *gyrus occipitalis secundus* (the operculum) lies behind the Affenspalte and joins the angular gyrus; before doing so, however, it is itself joined by the third occipital which lies under the ⋈. Beneath this runs the *sulcus occipitalis inferior* just above the lower edge of the hemisphere. This fissure is well marked on both sides, giving off a vertical ascending branch, round which the second temporal convolution turns. On the right the middle part of this fissure is not visible from the side.

The median surface of the brain and the inferior aspect of the occipital and temporal lobes remain to be described. The *fissura calloso-marginalis* is very simple and so like that of the human brain that detailed description is needless. It begins on the right hemisphere far back on the mesial surface of the frontal lobe, and is uninterrupted. On the left the plan is much like that figured by Kükenthal and Ziehen. There is below a *sulcus rostralis* with which the *calloso-marginalis* is joined by a little fissure so minute and shallow that the junction is more apparent than real. Behind its termination is the *lobulus quadratus* which is connected with the *arcus parieto-occipitalis* above and with the *gyrus fornicatus* below. The last named convolution and its continuation, the *gyrus hypocampi*, are uninterrupted on the right. On the left it is divided by the *fissura calcarina*. The *uncus* is well marked.

The internal parieto-occipital fissure is similar on both sides. Seen from the mesial surface, it appears to split above into two parts. The posterior one is the true fissure, being continued out into the convexity as above described. The anterior branch just passes the upper border of the hemisphere. The *gyrus intercuneatus* is made out by separating the parts as far as possible. It is quite hidden, being very deeply placed. Should it rise to the surface, it would separate the internal parieto-occipital fissure from the external, making the former end anteriorly to the latter, as Benham has

shown. The lower end of this fissure divides into two small branches which connect with no other fissure. In the right hemisphere the posterior division almost cuts through the gyrus separating it from the calcarine fissure.

The calcarine fissure differs in one important respect in the two sides. In both it ends in a fork very near the hind end of the brain. On the left it opens into the *fissura hypocampi;* on the right it joins what seems to be a peculiar collateral fissure. A deep fissure is seen in the cuneus, which, according to Kükenthal and Ziehen, is very constant in the chimpanzee. On the left the cuneus sends a convolution to the gyrus hypocampi just above the end of the calcarine fissure; on the right, owing to the peculiarity of the calcarine fissure, this gyrus seems to run more directly into the *gyrus hypocampi.*

The under side of the temporal lobe presents a very different appearance in its anterior half, which is frankly inferior, and in the posterior portion, which slants into the oblique inferior occipital surface. The former shows large simple convolutions. The latter is broken up by many secondary sulci. The former shows the ends of the first and second temporal convolutions passing obliquely forward from the outside of the brain and behind them the third which is quite plain on the under surface of the left half, but not clear on the right. The left collateral fissure is perhaps best described as splitting posteriorly into two parallel divisions. The *lobulus lingualis* lies between the inner of these divisions and the *fissura calcarina.* The *lobulus fusiformis* is between the two divisions.

On the right the *fissura calcarina* runs obliquely outward across the under surface of the temporal lobe to end in a short fissure which represents the separated anterior portion of *fissura collateralis.* The posterior part of this fissure is in its proper place. The *lobulus lingualis* is cut off by the abnormal direction of the *fissura calcarina.* The arrangement is, so far as I know, an undescribed one.

EXPLANATION OF THE PLATES.

PLATE 7.

Fig. 1. Foot.
Fig. 2. Hand.

PLATE 8.

Fig. 1. Caecum. The appendix runs along the lower edge to the left of the caecum till lost to sight behind the ileum.

Fig. 2. Inside of caecum. The ileo-caecal valve is seen above. Below this a valvular fold in the caecum, and still lower the opening of the appendix.

Fig. 3. The upper end of the left femur, showing a small, but distinct, third trochanter.

PLATE 9.

Fig. 1. The outer surface of the left hemisphere of the brain.
Fig. 2. The outer surface of the right hemisphere of the brain.

PLATE 10.

Fig. 1. The brain seen from above.
Fig. 2. Inner aspect of the right hemisphere.

LETTERING USED IN PLATES 9 AND 10.

af. Affenspalte: sulcus occipitalis transversus.
fc. Fissura calcarina.
f. coll. Fissura collateralis.
f. p. o. Fissura parieto-occipitalis.
f. po. ext. Fissura parieto-occipitalis externa.
f. R. Fissure of Rolando: fissura centralis.
r. asc. f. s. Ramus ascendens, vel anterior, fissurae Sylvii.
s. c. m. Sulcus calloso-marginalis.
s. i. p. Sulcus intra-parietalis.
s. oc. ob. Sulcus occipitalis obliquus.
s. o. f. Sulcus orbito-frontalis.
s. o. i. Sulcus occipitalis inferior.
s. pc. i. Sulcus praecentralis inferior.
s. pc. s. in plate 10 should be r. s. i. p. for the separated superior branch of the intraparietal fissure.
s. sub. c. a. Sulcus subcentralis anterior.
s. sub. c. p. Sulcus subcentralis posterior.
? Vide page 48.

DWIGHT. ANATOMY OF CHIMPANZEE.

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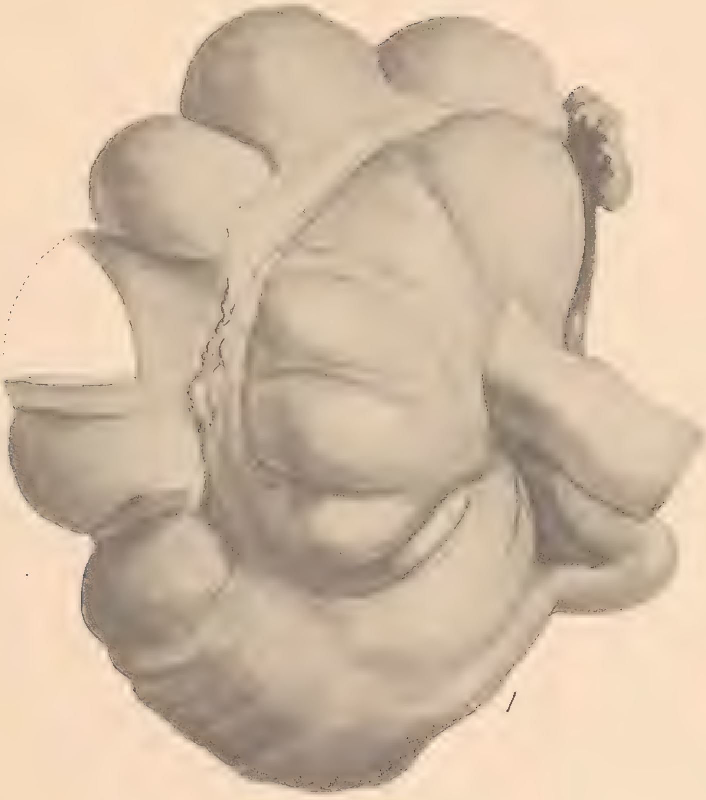

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DWIGHT. ANATOMY OF CHIMPANZEE


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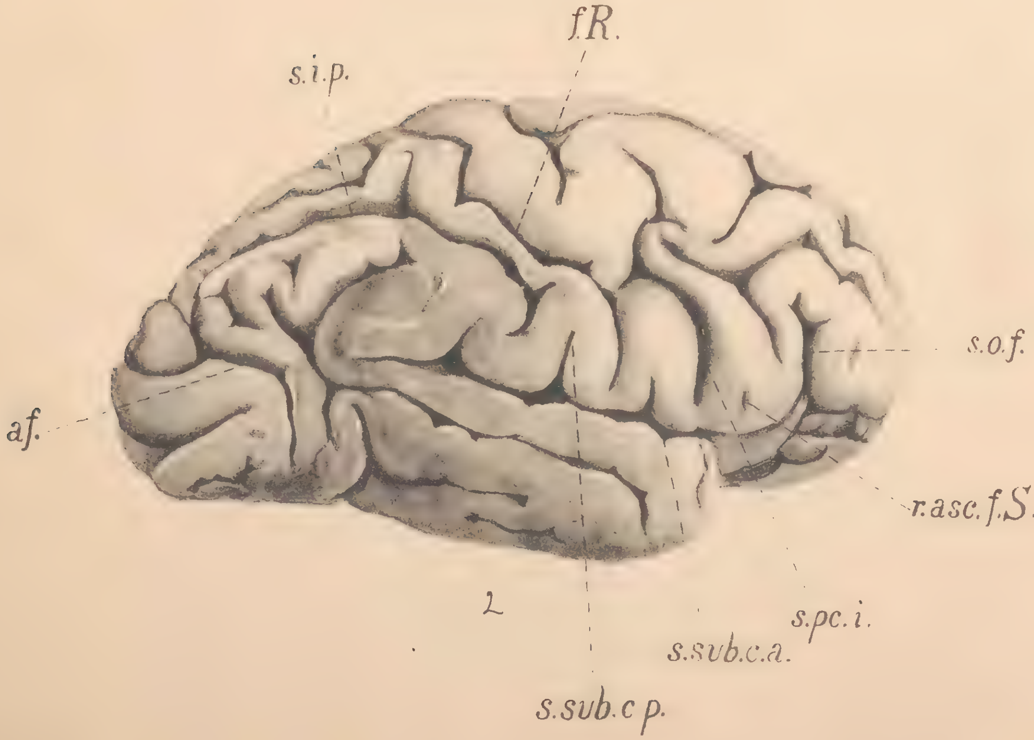
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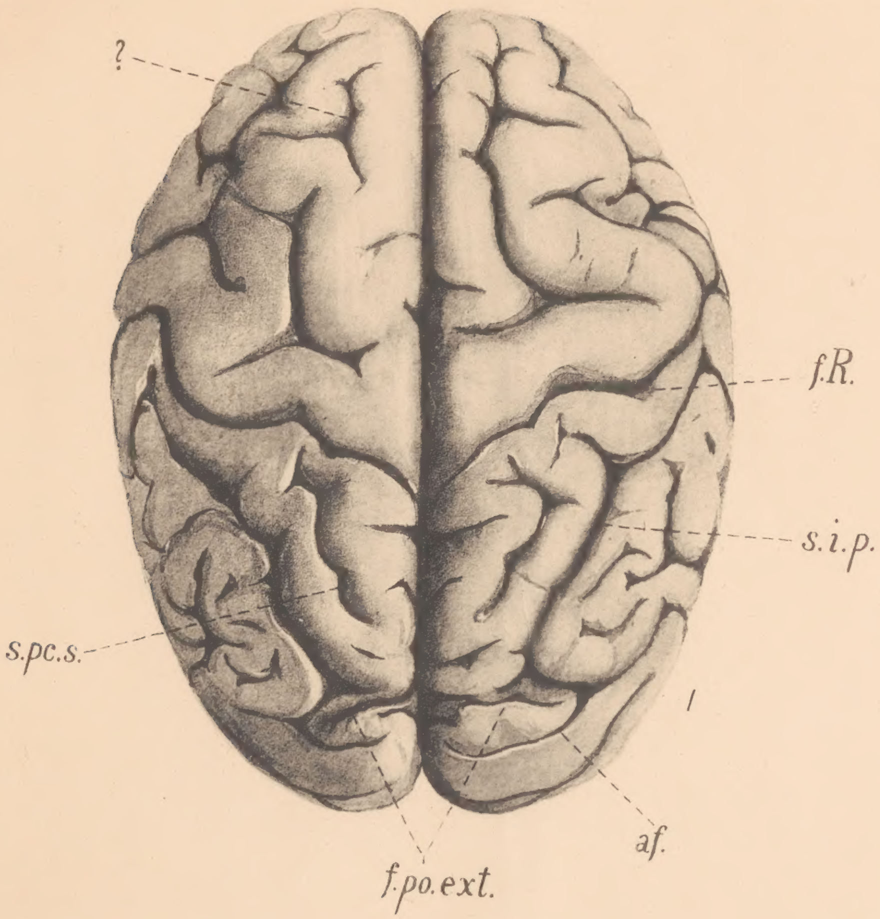

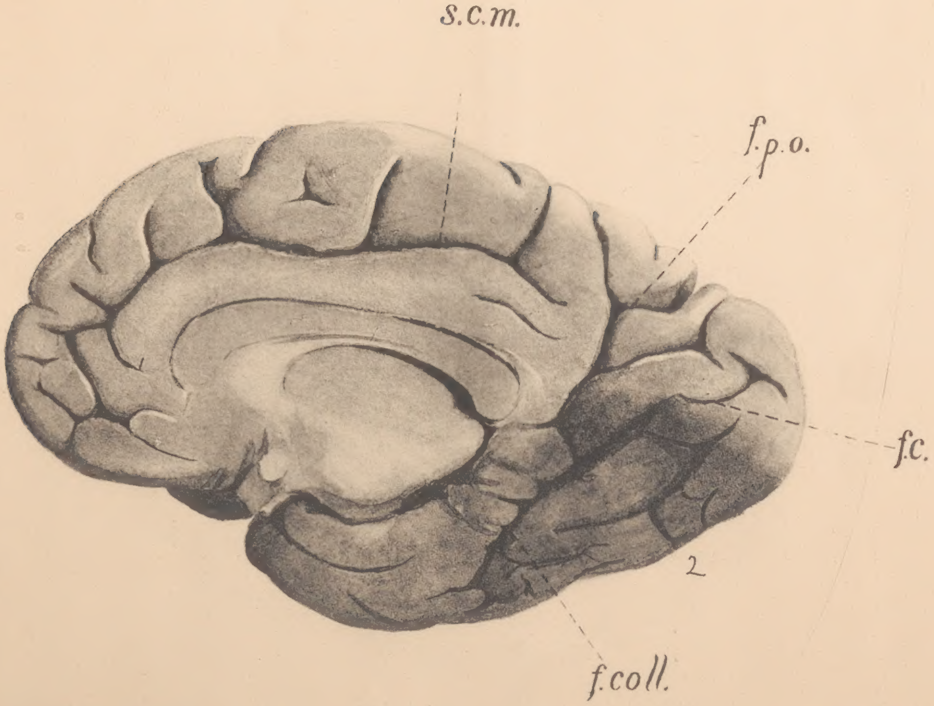

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